# EERE FY 2018 Budget Request

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Office of Energy Efficiency and Renewable Energy

May 22, 2017

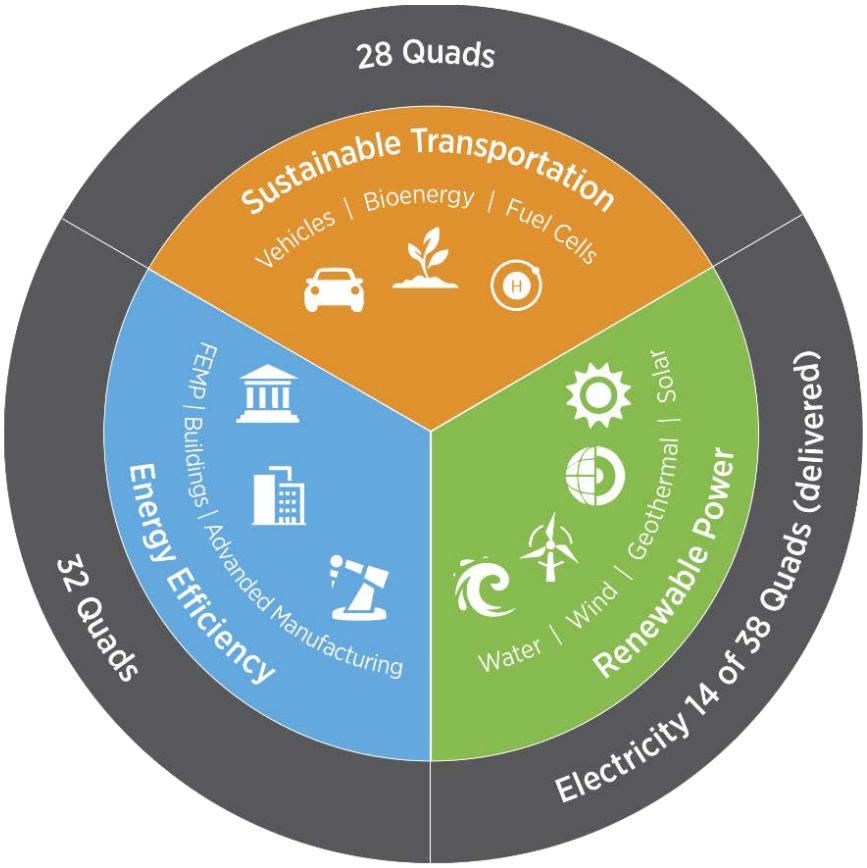
# Key Budget Themes and Administration Priorities

- Focuses U.S. Department of Energy (DOE) funding for the Office of Energy Efficiency and Renewable Energy (EERE) on limited, early-stage applied energy research and development (R&D) activities where the Federal role is stronger.
- The Budget emphasizes energy technologies best positioned to enable American energy independence and domestic job-growth in the near to mid-term.
- The Trump Administration is committed to energy policies that lower costs for hardworking Americans and maximize the use of American resources.
- Boosting domestic energy production is in America's national security interest. A brighter future depends on energy policies that stimulate our economy, ensure our security, and protect our health.
- Protecting clean air and clean water, conserving our natural habitats, and preserving our natural reserves and resources will remain a high priority.

These themes and priorities can be found in the America First Budget Blueprint and An America First Energy Plan on the whitehouse.gov website.

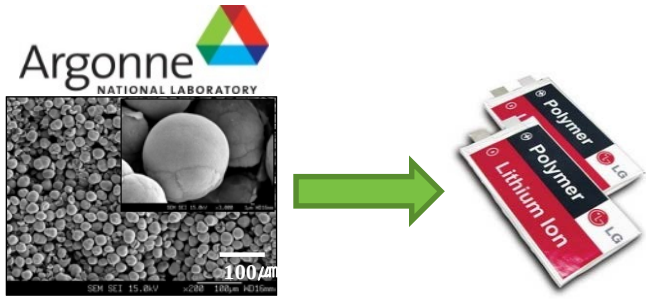
# Critical Investments Necessary to Sustain America's Leadership in Transformative Science and Emerging Energy Technologies

## A Proven Track Record in Early-Stage R&D Investments Across EERE's Three Sectors

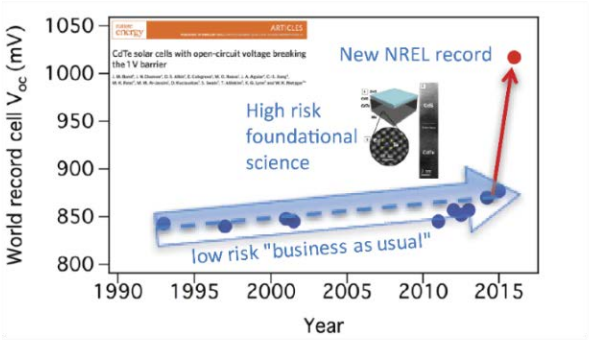



Total U.S. Economy 98 Quads
(EIA, 2015)

### Advanced Cathode Material for Lithium Ion Batteries




### Thin Film Photovoltaics




### Solid State Lighting

- $8.00/yr
- 60 Watts
- 1000 hour life

- 15 Watts (or less)
- 75% less energy
- $2.00/year
- Up to 25,000 hours

# FY 2018 Budget Request

| ($ Millions) | FY 2018 Request |
|---|---|
| **Sustainable Transportation** | **183.6** |
| **Vehicle Technologies** | **82.0** |
| **Bioenergy Technologies** | **56.6** |
| **Hydrogen and Fuel Cell Technologies** | **45.0** |
| **Renewable Electricity** | **134.3** |
| **Solar Energy Technologies** | **69.7** |
| **Wind Energy Technologies** | **31.7** |
| **Water Power Technologies** | **20.4** |
| **Geothermal Technologies** | **12.5** |
| **Energy Efficiency** | **159.5** |
| **Advanced Manufacturing** | **82.0** |
| **Federal Energy Management Program** | **10.0** |
| **Building Technologies** | **67.5** |
| **Weatherization and Intergovernmental Programs** | **0.0** |
| Weatherization Assistance Program | 0.0 |
| State Energy Program | 0.0 |
| **Corporate Support Programs** | **217.8** |
| **Program Direction** | **125.8** |
| **Strategic Programs** | **0.0** |
| **NREL Facilities and Infrastructure** | **92.0** |
| **Subtotal, EERE** | **695.2** |
| Rescission of Prior Year Balances | 0.0 |
| Use of Prior Year Balances | (59.1) |
| **Total, EERE** | **636.1** |

# Sustainable TRANSPORTATION

**Office of Energy Efficiency and Renewable Energy**

U.S. Department of Energy

# Transportation Sector Overview

**The overarching objective of the *Sustainable Transportation* portfolio is to improve U.S. energy security, economic productivity, and competitiveness while providing unprecedented access to domestic, clean fuels and efficient, convenient, and affordable transportation choices**

**Focus of the FY 2018 Request –** Early-stage research and development that advances fuel diversification, vehicle efficiency, and energy efficient mobility systems

## Technology Offices

**Vehicles**

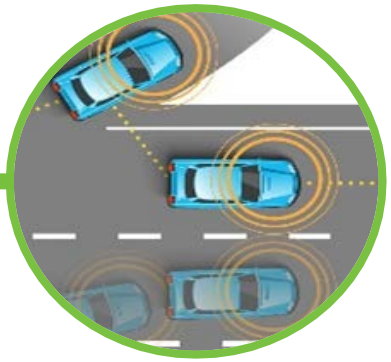
**Bioenergy**

**Hydrogen & Fuel Cells**

## 3 Key Technology R&D Areas

**Fuel Diversification**
Domestic, Diverse, Alternative, Clean Fuels

**Vehicle Efficiency**
Energy Efficient Vehicle Technologies



**Mobility Systems**
Energy Efficient Transport Systems

# Sustainable Transportation Highlights

## Vehicle Technologies ($82 million)

- **Advanced Battery R&D:** Develop battery technology that reduces the cost of Electric Vehicle batteries by more than half, to less than $100/kilowatt hour (kWh), increases range to 300 miles and decreases charge time to 15 minutes or less
- **Advanced Engines and Fuels:** Develop the next generation of combustion technology and fuels to improve the fuel economy of light-duty vehicles by 50% (versus 2009 baseline)
- **Advanced Materials Research:** Develop innovative and cost effective technology to build light weight, multi-material structures, reducing vehicle weight 25%
- **Energy Efficient Mobility Systems:** Create cutting-edge modeling, simulations and Artificial Intelligence/Big Data tools to improve energy efficiency of the overall mobility system

## Bioenergy Technologies ($56.6 million)

- **Advanced Algal Systems**: Multi-laboratory (lab) consortium to develop promising algae strains to improve algae strain productivity and yield
- **Feedstocks and Supply Logistics**: Improve the quality and consistency of bioenergy feedstocks with a specific emphasis on Feedstock-Conversion Interface R&D to improve downstream conversion efficiency.
- **Conversion**: Synthetic biology of engineered organisms and development of novel catalysts to improve yields and selectivity of renewable chemicals and drop-in biofuels
- **Advanced Development and Optimization**: Co-Optimization of Fuels and Engines to develop bio-based fuels/additives that enable 15-20% fuel economy gain when blended with petroleum and used in high-efficiency engines
- **Strategic Analysis and Sustainability**: Pathways to achieve target of $2/gasoline gallon equivalent (gge); sustainability research into strategies for increasing bioenergy production without detriment to food security, air, land, and water

# Sustainable Transportation Highlights (cont.)

## Hydrogen and Fuel Cell Technologies ($45 million)

- **Hydrogen Fuel R&D**: Hydrogen production, delivery, storage and safety R&D to achieve $4/gge; focus on multi-lab consortia with university and industry partners
- **Fuel Cell R&D:** Platinum-free catalysts, innovative membranes and electrodes for breakthroughs in fuel cell cost to achieve $40/kWh and 5,000 hour target (includes multi-lab consortia plus university and industry partners)
- **H2@Scale (Hydrogen at Scale):** A framework for the potential wide-scale production and utilization of hydrogen across sectors; focus on materials R&D (liners, pipeline, infrastructure components etc.) and advanced liquefaction technologies

# Renewable POWER

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U.S. Department of Energy

# Renewable Power Sector Overview

**The overarching objective of the *Renewable Power* portfolio is to enable the adoption of affordable, reliable and renewable electricity options to the nation's energy mix, allowing for regional optimization, maximizing the use of indigenous resources, and contributing to a resilient, reliable, and secure electricity grid.**

**Wind Energy Technologies Office**

**Solar Energy Technologies Office**

**Water Power Technologies Office**

**Geothermal Energy Technologies Office**

### Technology Innovation

- Reduce costs of energy production
- Improve performance of new technologies

### Device Validation & Analysis

- Analyze and validate new technology to inform R&D
- National Laboratory facilities and capabilities

### System Integration

- New technologies that can improve grid services
- Grid integration activities coordinated with the DOE Office of Electricity Delivery and Energy Reliability

# Renewable Power Highlights

## Wind Energy Technologies ($31.7 million)

- **Atmosphere to Electrons (A2e):** Optimize the design and improve the performance of next-generation wind plants, including complex terrain resource characterization, wake steering control, high-fidelity wake modeling, and novel imaging sensors
- **National Lab Facilities:** Next-generation testing methodologies, component testing, and high-fidelity data at the National Wind Technology Center (WTC) and Scaled Wind Farm Technology Facility (SWiFT), including A2e verification and validation at SWiFT, and reliability testing for high-speed and main-shaft bearings at NWTC
- **Technology Innovation RD&T:** Fundamental research in controls, sensors, algorithms, manufacturing, materials, and reliability to lower operations and maintenance (O&M) costs and improve reliability and operational performance, particularly design and manufacturing of rotors for tall wind

## Solar Energy Technologies ($69.7 million)

- **High-Performance Photovoltaic Materials:** Researching and validating advanced materials and devices to improve performance while reducing cost; focus on understanding reliability physics and materials science to refine modeling, increase efficiency and durability
- **Grid Integration of Solar Power:** Integration of solar power, including cyber security, two-way power flow, voltage and frequency control, reliability, and operations science; specifically, integration studies linking the grid, loads, and storage with power system planning and operation, sensors and feedback control loops, communication integrity, and data analytics
- **Next Generation Concentrating Solar Power with Thermal Energy Storage:** High-temperature components for next generation systems with thermal storage, including advanced diffusion-bonded heat exchangers, unique to U.S. manufacturing, and new concepts for harvesting light
- **Techno-Economic Analysis**: Creation and validation of modeling beyond Levelized Cost of Electricity to establish time, location and scale value of solar, integrating grid, load and storage aspects to inform research priorities

# Renewable Power Highlights (cont.)

## Water Power Technologies ($20.4 million)

- **Advanced Marine and Hydrokinetic (MHK) System Design & Validation:** Accelerate cost reduction and energy capture gains for wave and current energy systems, including advanced controls, improved early-stage design models, and aggregation of data to reduce development costs
- **Standard Modular Hydropower Systems:** New modular designs that lower costs and impacts of new hydro generation, including modeling site-specific environmental-structural interactions and competed industry projects to validate and optimize designs
- **Hydropower Turbine Design:** Provide tools for improved turbine design and evaluation, incorporating computational models of water flow and biological interactions that enable industry innovation and optimize operation across multiple mandates
- **Hydropower Grid Reliability Support:** Enable multiple run-of-river hydro plants to operate as a single, dispatchable system; analysis of the cost and value of hydropower to provide grid reliability services

## Geothermal Technologies ($12.5 million)

- **Enhanced Geothermal Systems Collaborative (EGS Collab) Consortium:** Collaborative teams developing centralized small scale testing facility(ies) focusing on the relationship between seismicity, stress state, and permeability, and the validation of thermo-hydro-mechanical-chemical models; includes Experiment 2 at the Sanford Underground Research Facility (SURF) Mine in South Dakota, which addresses shear stimulation and mixed mode fracturing
- **Hydrothermal R&D**: Supports the third and final year for three national lab projects targeting innovative approaches to reducing the cost of geothermal exploration:
  - *Microhole drilling* allows smaller wells to be drilled cheaper and faster, while still capturing necessary data for resource evaluation
  - *Self-healing cements* are a major cost saving activity for well completions, reducing the instances of wellbore collapse
  - Innovative *subsurface imaging* allows for more discrete targeting of wells, increasing the probability of drilling a successful well

# Energy Saving

## HOMES, BUILDINGS, & MANUFACTURING

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U.S. Department of Energy

# Overview of Energy Efficiency and Manufacturing

## Drive Innovation – reduce technology costs and risk

- High impact energy savings opportunities
- Bringing building science to buildings
- Systems integration R&D
- Next generation manufacturing

## Enable Federal Leadership in Energy Efficiency

- Steward federal facilities; reduce costs
- Agency technical assistance; third-party financing

## Congressional Regulatory Requirements

- Appliance and equipment standards
- Building energy codes determinations
- Federal building energy standards

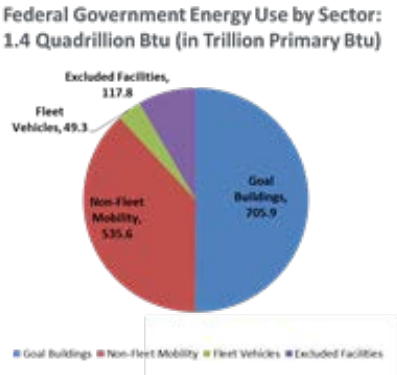
## Termination of Weatherization Assistance Program (WAP) and State Energy Program (SEP)

## Advanced Manufacturing Office

- Next generation processes/materials R&D
- Broadly applicable and for energy-intensive industries
- Rare Earth Materials R&D – limit supply chain volatility

## Building Technologies Office

- Technology R&D;  20 - 80% savings
- Homes & Building Systems R&D; 50% savings
- Sensors/controls/grid integration R&D
- Appliance standards




**$21.3 billion energy bill (FY15)**

## Federal Energy Management Program

- Reduce energy costs for federal facilities and fleets
- Financing and technology technical assistance
- Skills training/tools
- Federal accountability

# Energy Efficiency Highlights

## Advanced Manufacturing ($82 million)

- **High-Performance Computing (HPC) for Manufacturing:** National Lab Supercomputers on manufacturing-based scientific challenges to discover new knowledge in advanced materials & processes
- **Lab-University-Manufacturer Research Consortia [Hub/Spoke Public-Private Partnerships]:** Research Consortia on manufacturing science and technology at National Labs for Additive (3D Printing), Carbon Fiber Composites, Rare Earths, Chemical Process Intensification, Smart Information and Communication Technologies, Advanced Materials, and Power Electronics
- **Early-Stage Research Projects at Labs & Universities:** Manufacturing science challenges for Advanced Catalysis, Roll-to-Roll processes, Thermal Intensification, Clean Water, Advanced Semiconductors, Materials Manufacturing and Advanced Combined Heat and Power
- **Industry-University-Lab Technical Partnerships for Manufacturing:** Industry partnerships for knowledge creation and dissemination on new technologies for energy productivity in manufacturing; research and verification on new tools and technologies for subsequent implementation by the private sector

## Building Technologies ($67.5 million)

- **Buildings to Grid R&D:** Key building blocks for cyber physical systems for buildings, including advanced communication platforms and data management systems; digital sensing, monitoring, and control capabilities; and data analytics to ensure assets are secure and resilient
- **HVAC & Refrigeration R&D:** Solid state cooling materials and non-vapor compression solutions, such as research into the discovery of materials for magneto-caloric, electro-caloric, thermo-electric and thermo-tunneling effects for heating, cooling, and refrigeration
- **Solid State Lighting R&D:** Critical R&D challenges on semiconductor physics behind light-emitting diode (LED) & Organic LED (OLED) technologies, materials deposition, and device fabrication processes and investigations
- **Commercial & Residential Building Integration R&D:** Integrate component research into efficient next generation building construction and retrofit design
- **Equipment and Building Standards:** Meeting statutory obligations

# Energy Efficiency Highlights (cont.)

## Federal Energy Management Program ($10 million)

- **Technical Assistance Leveraging Performance Contracting & Power Purchase Agreements:**
  - Assist federal agencies with energy-savings and infrastructure investments, leveraging private-sector financing, without up-front capital costs, reducing the cost to the government
  - Support performance savings contracts (through new $55 billion indefinite delivery/indefinite quantity contract), utility energy savings contracts, and power purchase agreements for energy and water efficiency improvements and demand reduction services, building upon recent efforts of almost $1 billion investment per year

- **Statutory Requirements, Workforce Development, & Agency Engagement:**
  - Fulfill statutory requirement to hold agencies accountable for energy management performance
  - Work with organizations to enhance the skills and agility of the existing workforce in the field of energy management and security, including for Veterans

## Weatherization and Intergovernmental Programs ($0.0 million)

- No funding is requested for the Weatherization Assistance Program (WAP) or the State Energy Program (SEP)
- Management and oversight activities for grants awarded using FY 2017 funds and prior year appropriations will continue at declining levels over the next five fiscal years

# Mission-Critical Support

## OPERATIONS

**Office of Energy Efficiency and Renewable Energy**

U.S. Department of Energy

# Facilities, Program Direction, and Strategic Programs Highlights

## NREL Facilities & Infrastructure ($92 million)

- **Operations and Maintenance**
  - Sustains world-class research facilities, maintains Asset Condition Index >0.97; completes Wind Test Center capacity upgrade from 10-20 megawatts; renovates laboratories to create leading-edge Microbial Energetic Laboratory; and prioritizes Cybersecurity
- **Energy Systems Integration Facility**
  - Invests in initial phase to double HPC capacity to meet growing demand; provides for systems engineers, technicians, management and safety personnel for Energy Systems Integration Facility experiments; establishes university and industry partnerships focusing on grid modernization through "User Facility" calls, Cooperative Research and Development Agreements and "Work For Other" agreements

## Program Direction ($125.8 million)

- Achieves cost savings by aligning workforce to smaller EERE program – 458 Full-Time Equivalents (30% reduction)
- Consolidates procurement and project management functions at Golden Field Office (eliminates National Energy Technology Laboratory support)

## Strategic Programs ($0.0 million)

- Improves operational efficiency by transferring Strategic Programs Office functions of international, technology-to-market and external communications to DOE International Affairs, Office of Technology Transitions and Public Affairs